POSTOPERATIVE NAUSEA AND VOMITING (PONV) AFTER ORTHOGNATHIC SURGERY: A PROSPECTIVE STUDY

Dissertation submitted to
THE TAMILNADU DR. MGR MEDICAL UNIVERSITY

In partial fulfillment for the degree of
MASTER OF DENTAL SURGERY

BRANCH III
ORAL AND MAXILLOFACIAL SURGERY
APRIL 2011

CERTIFICATE

This is to certify that this dissertation titled " **POSTOPERATIVE NAUSEA AND VOMITING (PONV) AFTER ORTHOGNATHIC SURGERY: A PROSPECTIVE STUDY.**" is a bonafide record of work done by **Dr. G.MRUDUL MANOJ** under our guidance and to our satisfaction during his postgraduate study period **2008-2011.**

This Dissertation is submitted to THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY, **in partial fulfillment for the award of the Degree of** MASTER OF DENTAL SURGERY– ORAL AND MAXILLOFACIAL SURGERY BRANCH III. **It has not been submitted (partial or full) for the award of any other degree or diploma.**

Guided by

13/12/10

Dr.Malini Jayaraj, MDS,
Professor
Department of Oral and Maxillofacial Surgery
Ragas Dental College and Hospital

Dr.M.Veerabahu MDS,IOBMS
Professor and Head of Department
Department of Oral and Maxillofacial Surgery
Ragas Dental College and Hospital

Dr.S. Ramachandran, MDS,
Principal,
Ragas Dental College and Hospital

Date: 13-12-10

Place: CHENNAI

Dr. M. VEERABAHU, MDS,IBOMS
Professor & HOD
Dept of OMFS
RAGAS DENTAL COLLEGE & HOSPITAL
Uthandi, Chennai - 600 119.

PRINCIPAL
RAGAS DENTAL COLLEGE AND HOSPITAL
UTHANDI, CHENNAI-600 119

RAGAS DENTAL COLLEGE Chennai

ACKNOWLEDGEMENT

I am greatly indebted to ***Dr. M.VEERABAHU,*** *Professor and Head of the Department, for his incessant support, invaluable teachings and a balance of encouragement and positive criticism at both personal and professional front throughout my training period. His unmatched quality of being a great surgeon and teacher and simultaneously possessing a calm wisdom and modest nature has always been a source of inspiration.*

I would like to extend my sincere gratitude to Professor ***Dr. S. RAMACHANDRAN****, Principal, for allowing us to use the scientific literature and other facilities of the college.*

I thank my Guide and Professor ***Dr. MALINI JAYARAJ*** *from the bottom of my heart for the inestimable guidance, unstinted support, constructive discussions and instilling a unique ability to present things in the best of ways. Her loving and caring nature has lightened the burden of many hardships. Without her presence and supervision, my training and this dissertation would have been incomplete.*

I owe enormous debt of gratitude to my Professor ***Dr. J.A. NATHAN*** *for his valuable guidance and support throughout my course. I also thank him for guiding me and teaching me the essence of implantology.*

*I would also like to thank Professor **Dr. B. VIKRAMAN**, for his precious advices, generous support and plentiful knowledge he has shared. I will always be benefitted from the distinctive quality imparted in us to look into problems from all three dimensions. His subtle humor and comments have been thoroughly enjoyed.*

*I would like to express my heartfelt and sincere gratitude to **Dr. R. SRIPAL,** Associate Professor, who has been a friend and an exceptional teacher at the same time, for sharing his knowledge, continuous support, encouragement and intellectual motivation. I wish I never forget his three favorite words "Read, Read, Read".*

*I am greatly indebted to **Dr. RADHIKA KRISHNAN,** Anesthesiologist, for her valuable suggestions and constant encouragement throughout my study.*

*I sincerely thank **Dr. EMMANUEL** for his valuable support and guidance and his scholarly ideas and comments.*

*I would also like to extend my gratitude to **Dr. VENKAT**, who always has stood by all the postgraduates and provided them with valuable advices and guidance.*

*I thank **Dr. SHANKAR,** who has helped, guided, taught and supported us not only as a teacher, but as an elder brotherly figure.*

*I thank **Dr. MUTHUMANI,** who has been instrumental in my learning curve both as a senior colleague and later as a staff.*

*I would also like to thank **Dr. PRABHU,** for his valuable suggestions and guidance.*

*I would also like to thank **Dr.VEENESH** , for his valuable suggestions and guidance.*

*I would like to thank all my colleagues **Dr. Anupam, Dr. Daniel, Dr. Riyaz, Dr. Sakthivel, Dr. Sathish,** who have accompanied me through ups and downs of my training period.*

*I would also like to extend my sincere gratitude to the **PARAMEDICAL and NON-TEACHING STAFF** of the institution for their support and help.*

*I would be doing injustice to my **PARENTS and BROTHER** if I try finding words to thank them.*

*I thank **THE ALMIGHTY,** who has always poured in his blessings and grace and mapped out every success path I have traversed in my life, to help me become a better person and surgeon and be able to justify the purpose of my existence.*

INTRODUCTION

Nausea and vomiting may occur independently of each other but generally are closely allied and are presumed to be mediated by the same neural pathways, and so they be considered together.[1,35]

Nausea denotes the feeling of an imminent desire to vomit, usually referred to throat or epigastrium.

Vomiting or emesis refers to forceful oral expulsion of gastric contents.

Retching denotes labored rhythmic contraction of respiratory and abdominal musculature that frequently precedes or accompanies vomiting.

Nausea often precedes or accompanies vomiting .It is usually associated with diminished functional activity of stomach; that is hypotoxicity, hypoperistalisis, hyposecretion and altered small intestinal motility. (hypertoxicity, reversed peristalsis of duodenum)

Often accompanying severe nausea is evidence of altered autonomic, especially parasympathetic activity such as skin pallor, increased perspiration, hypersalivation, Anorexia, defecation, occasionally hypotension and bradycardia (vasovagal syndrome). Nausea, retching, hypersalivation frequently precede the act of vomiting which is highly integrated sequence of involutary visceral and somatic motor events.

The stomach plays a relatively passive role in the vomiting process, the major ejection force being provided by the abdominal musculature.

With relaxation of gastric fundus and gastroesophageal sphincter, a sharp increase in the intraabdominal pressure is brought about by a forceful contraction of the diaphragm and abdominal wall muscles . This together with concomitant annular contraction of gastric pylorus, results in the expulsion of gastric contents into the oesophagus. Increase intra thoracic pressure results in the further movement of the oesophageal peristalsis which may play a role in this process. Reflex elevation of the pylorus during the vomiting act prevents the entry of the expelled material into the nasopharynx, whereas reflex closure of the glottis and inhibition of respiration help to prevent pulmonary aspiration.

Orthognathic surgery

The word “Orthognathic” comes from the greek word “ortho” meaning to straighten and “gnathia” meaning jaw and thus orthognathic surgery means to straighten a jaw.[41]

Orthognathic surgery is defined as the art and science of diagnosis, treatment planning and execution of treatment to correct musculoskeletal dento-osseous and soft tissue deformities of the jaws and associated structures.

It is the surgery to correct conditions of the jaw and face, related to structure, growth, sleep apnea, TMJ disorders or to correct orthodontic problems that cannot be easily treated with braces. Originally coined by Dr. Harold Hargis, D.M.D., it is also used in treatment of congenital conditions like cleft palate. Bones can be osteotomised and realigned, held in place with plates and screws.

The surgery might involve one jaw or both jaws during the same procedure. The modification is done by making osteotomies in the bones of the mandible and / or maxilla and repositioning the osteomised segments in the desired alignment. Usually surgery is done under general anaesthesia performing nasotracheal intubation. This is to allow intermaxillary fixation during the surgery. The surgery often does not involve incising the skin by extra oral approach, instead the surgeon is often able to use an intraoral approach.

Osteotomy refers to simple bone cut. Whereas, ostectomy means the removal of portion of bone. The fundamental biology behind the orthognathic surgery is that maxillary and mandibular bones are intraorally sectioned and repositioned at the desired site to correct dentofacial deformity. Various maxillary osteotomies performed include lefort I, lefort II, lefort III, anterior maxillary osteotomy, posterior maxillary osteotomy. Commonly performed mandibular osteotomies include bilateral saggital split osteotomy, subapical osteotomy, genioplasties and body osteotomies.

Undoubtedly orthognathic surgery is associated with many complications, one of which and most distressing to the patient is postoperative nausea and vomiting.

Though Postoperative nausea vomiting is not life threatening, it can be quite distressing for the patient and often considered a “big little problem”.[21]

Causative factors have been categorized into surgical, anesthetic, non anesthetic and postoperative factors [1]. A number of factors have emerged which are associated with the problem. These include age, sex, history of motion sickness, previous PONV, vertigo or migraine, smoking status, type of volatile anaesthesia duration, type of surgery, pre anesthetic medication, the use of opiates, early postoperative ambulation, timing of oral intake, postoperative pain and use of postoperative analgesic drugs. There are infinite number of permutations that may lead to an unfavorable outcome.

It is also important to take cognizance of these factors in the design of the study of PONV to avoid bias.

Repeated emesis may have deleterious effects in a number of ways. The process of vomiting if forceful may lead to pressure rupture of oesophagus or to linear mucosal tears in the region of cardio-oesophageal junction with resulting hematemesis. Prolonged vomiting may lead to dehydration, loss of gastric secretion resulting in metabolic alkalosis with hypokalemia. Gastric contents may be aspirated into the lungs resulting in aspiration pneumonitis.

Apart from medical complications, PONV have psychological effects that may result in patient experiencing anxiety about undergoing further surgery. Numerous modalities including identifying the risk factors in patients, variation in anaesthetic technique, prophylactic antiemetic administration have been used in an effort to decrease the incidence of PONV.

Hypotensive anesthesia

The deliberate induction and maintenance of intraoperative hypotension are adjuncts for major maxillofacial orthognathic surgery. This is particularly true for procedures involving the midfacial skeleton or harvesting of cranial bone. Deliberate reduction of blood pressure is common for neurovascular and orthopaedic surgery, and techniques learned have been applied to patients undergoing orthognathic surgery. The three principle benefits of hypotensive anaesthesia are reduction of intraoperative blood loss, improved visibility in the surgical field and reduced operative time [41]. The principle of hypotensive anaesthesia is to maintain the balance between the functions of the cardiorespiratory, metabolic, renal, endocrine and central nervous system functions and protect against irreversible changes in these organ systems[35]

Sodium nitroprusside (SNP) and nitroglycerin (NTG) are often used for hypotensive anaesthesia because they are potent vasodilators with predictable, shortacting and easily reversible effects. A significant reduction in blood loss

and an improvement in the quality of the surgical field have been achieved with controlled hypotensive anaesthesia induced using SNP or NTG. Prolonged hypotensive anesthesia can present with various complications. The brain , heart , kidneys and liver are the organs most vulnerable to ischemia when blood flow is below critical level. Another organ susceptible to problems during hypotensive anesthesia is skin. This can explain the disturbingly common occurance of ischemic damage to nasal ala from tube pressure.[41]

PATHOPHYSIOLOGY OF EMESIS

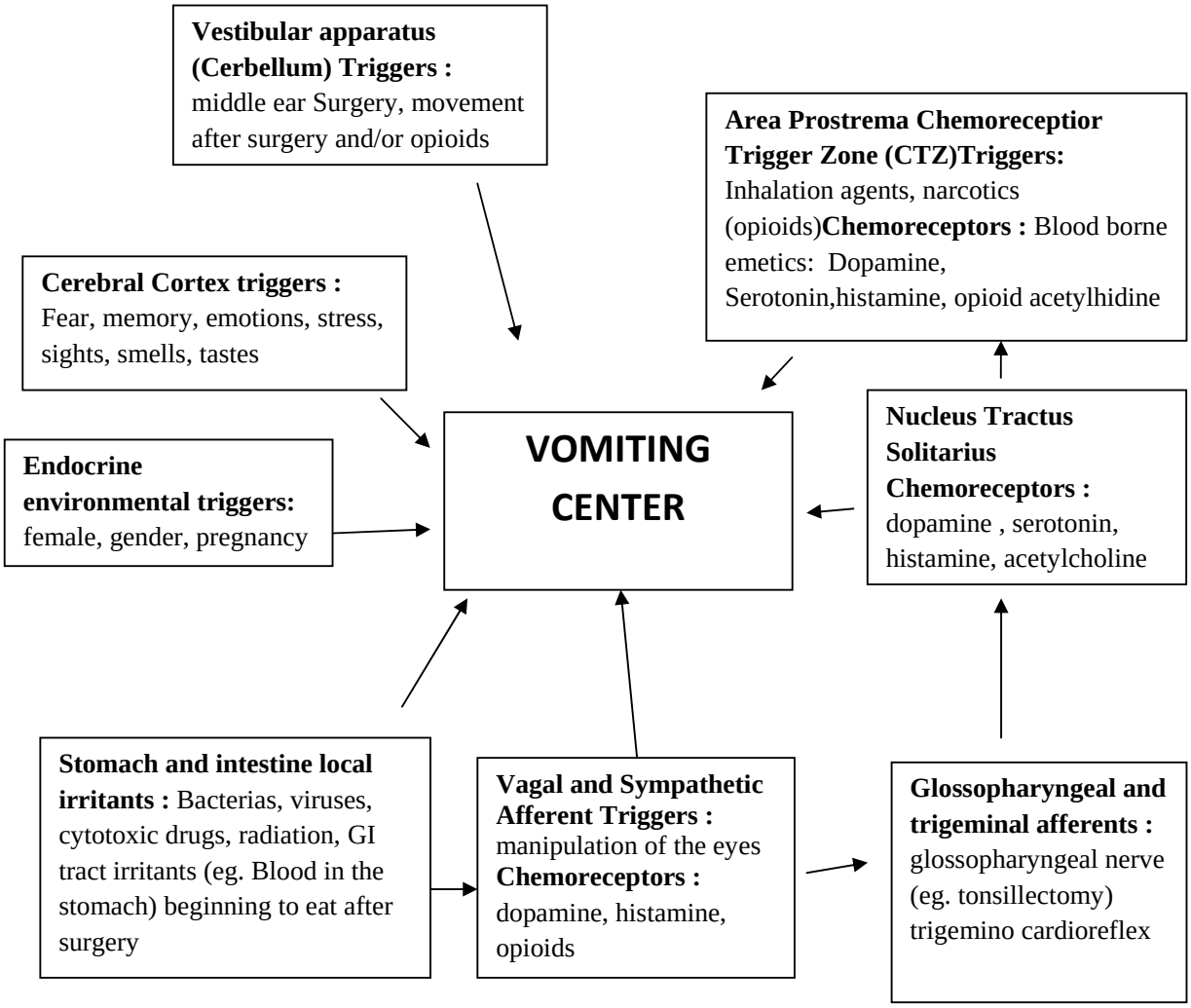
Vomiting Mechanism :

The act of vomiting is under the control of two functionally distinct medullary centres : [35] the vomiting center in the dorsal portion of the lateral reticular formation and the chemoreceptor trigger zone in the area postrema of the floor of the fourth ventricle. The vomiting centre controls and integrates the actual act of emesis. It receives afferent stimuli from the gastrointestinal tract and the other parts of the body, from higher brainstem and cortical centres, especially the labyrinthine apparatus, and from the chemoreceptor trigger zone. Persons vary considerably in the threshold of their vomiting center to different stimuli, The important efferent pathways in vomiting are the phrenic nerves (to the diaphragm), the spinal nerves (to the intercostals and abdominal musculature) and visceral efferent fibers in the vagus nerve (to the larynx, pharynx, esophagus and stomach). The vomiting centre is located near

other medullary centres regulating respiratory, vasomotor and autonomic functions that may be involved in the act of vomiting.

The chemoreceptor trigger zone by itself is incapable of mediating the act of vomiting; rather activation of this zone results in efferent impulses to the medullary vomiting centre, which in turn indicates emesis. The chemoreceptor trigger zone is emetic chemoreceptor that can be activated by a variety of stimuli or drugs, including apomorphine and other opiates, levodopa (after decarboxylation to dopamine), digitalis, bacterial toxins, radiation and metabolic abnormalities as occur with uremia and hypoxia.

The chemoreceptor trigger zone (CTZ) is in, or near, the area postrema and contains high concentrations of opioid, dopamine, muscarinic, histamine, cholinergic, serotonin or 5-hydroxytryptamine (5-HT3) neurochemical receptors, and serves as a chemosensor.



MECHANISM OF NEUROTRANSMITTER SYSTEM OF PONV[1]

AIMS AND OBJECTIVES

- To evaluate the incidence of postoperative nausea and vomiting after orthognathic surgery.

- To identify the risk factors causing postoperative nausea and vomiting in patients undergoing orthognathic surgery under general anesthesia

REVIEW OF LITERATURE

J.W. Dundee et al (1975)[16] The ability of cyclizine (50 mg) and perphenazine (2.5 and 5.0 mg) to counteract the emetic effects of pethidine (100 mg) and morphine (10 and 15 mg) was compared in women undergoing a standard minor operation with a standard anaesthetic. Perphenazine (5.0 mg) was as effective an anti-emetic as cyclizine (50 mg) and both were more effective than perphenazine (2.5 mg). The reduction in vomiting and nausea by cycizine (50 mg) and perphenazine (5 mg) was approximately the same following pethidine (100 mg) and morphine (10 mg) but much less against the larger dose of morphine. Both anti-emetics had a rapid onset of action but their anti-emetic activity did not last as long as the emetic effect of morphine. Perphenazine (5 mg) was accompanied by an unacceptably high incidence of restlessness. In clinical practice cyclizine (50 mg) is preferred to perphenazine (5 mg) as an antiemetic.

Carolyn M. Flanary et al (1983)[7] The authors surveyed 93 orthognathic surgery patients about presurgical concerns, preparation for the surgical experience, and postsurgical outcomes.

Nine of the 90 respondents indicated they would not re-elect the surgical treatment. Reasons for dissatisfaction varied, although all had in common the occurrence of unanticipated postsurgical events. The importance of effective preoperative preparation of patients cannot be overestimated. The authors have

written an information brochure to reinforce verbal orientation for the orthognathic surgery patient and family.

Claude A. Trtpanier et al (1993)[12] . Aspiration of gastric contents with an orogastric tube does not decrease postoperative nausea and vomiting in outpatients. Patients who receive this treatment had higher incidence of nausea and vomiting after their discharge from the day surgery unit.

Carrol et al (1995)[8] reported a prevalence of over 30% of postdischarge nausea and vomiting for up to 5 days after surgery.

David S. Precious et al (1997)[14] compared the effectiveness of patient-controlled intravenous (IV) opioid analgesic administration (PCA) with fixed schedule and dosage oral/rectal administration of naproxen, and opioid analgesics intramuscularly/orally as needed (IM/PO Prn) for postoperative analgesia over a period of 48 to 56 hours after surgery. There were 75 orthognathic patients aged 25.73+_8.01 years. Subdivided into three study groups of 25: codeine group; naproxen group and PCA group. The degree of analgesia was assessed every 4 hours from 8:00AM to 8:00 PM on days 1 and 2 post surgery using a visual analog scale. The PCA group used less than half the amount of morphine equivalent as the codeine group. Both the naproxen and the PCA groups were significantly more comfortable than the codeine group during day 1 and day 2 post surgery.

The codeine group had significantly more episodes of nausea than either the naproxen or the PCA groups. He finally concluded that patients

undergoing orthognathic surgery, naproxen and PCA regimens provided better analgesia than the codeine regimen.

Girish P. Joshi et al (1999)[20] suggested that the incidence of postoperative nausea and vomiting and the need for antiemetics do not increase with the use of neostigmine and glycopyrrolate for reversal of residual muscle paralysis.

Laara et al, (1999)[34] it appears that this risk score has broad applicability in predicting PONV in adult patients undergoing inhalational anesthesia for various types of surgery. For patients with at least two out of these four identified predictors a prophylactic antiemetic strategy should be considered.

Sinclair et al (1999)[47] A validated mathematical model is provided to calculate the risk of PONV in outpatients having surgery. Knowing the factors that predict PONV will help anesthesiologists determine which patients will need antiemetic therapy.

Paul F. White, et al (1999)[40] if patients experience breakthrough PONV despite prophylaxis, they should be treated with a drug from a group other than the one used for prophylaxis (e.g., metoclopramide).

Craig Wagley et al ,**(1999)**[13] conducted an investigation to evaluate the efficacy of ondansetron in controlling postoperative nausea and vomiting (PONV) when used prophylactically in patients undergoing routine dentoalveolar surgery performed under general anesthesia.

This was a prospective, double-blind, randomized, placebo-controlled evaluation. Fifty adult ASA I or II patients, requiring routine dentoalveolar surgery performed under general anesthesia, without a prior history of PONV, were randomly assigned to the experimental or control groups. Ondansetron (2.0 mL = 4.0 mg) or normal saline (2.0 mL) were administered intravenously before surgery. Age, gender, type of surgery, duration of surgery, anesthetic dosages, and PONV were evaluated. PONV was evaluated at time 0 (end of anesthesia) and at 30 and 60 minutes postoperatively.

Nausea was evaluated using a visual analog scale (1, not nauseous; 5, about to vomit). Vomiting was assessed as a yes or no response. At 20 to 28 hours postoperatively,

No significant differences ($P < .05$) were found between the PONV groups for gender, duration of procedure, or anesthetic dosages. No statistically significant differences ($P < .05$) were noted between groups for nausea or vomiting.

He finally concluded that, there were no significant differences between ondansetron and placebo for prophylaxis against PONVof nonresponders and intractable PONV.

Robert M. Dolman et al (2000)[42], conducted a prospective study to compare the quality of the surgical field, blood loss, and operative time with either hypotensive or normotensive anesthesia during Le Fort I osteotomies.

Twenty-three patients were randomized into normotensive or hypotensive anesthesia treatment groups. The quality of the surgical field was assessed intraoperatively by direct observation and again postoperatively using video imaging. A standardized rating scale was applied at specific intervals by surgeons blinded to the anesthetic technique. The surgical time was measured on the videotape, and blood loss was measured by volumetric and gravimetric techniques. There was a statistically significant correlation ($P < .0001$) between the surgeon's perception of the quality of the surgical field and the blood pressure. There was also a statistically significant reduction ($P < .01$) in blood loss when using hypotensive anesthesia. However, there was no statistically significant reduction in operative time when using hypotensive anesthesia. It was concluded that hypotensive anesthesia is valuable in reducing blood loss and improving the quality of the surgical field during Le Fort I osteotomies, allowing for easier, more deliberate, and careful dissection. However, it does not reduce operative time.

Jacqueline E. Jones et al (2001)[26] gastric aspiration does not decrease the incidence of vomiting following tonsillectomy.

Yi Lee et al ,**(2001)**[54] Desflurane is associated with a higher incidence of 24-h postoperative nausea and vomiting (PONV) as compared with sevoflurane or isoflurane. Dexamethasone 5 mg i.v. is suggested to be the minimum effective dose for prophylaxis of PONV in women undergoing thyroidectomy with isoflurane anesthesia. The objective of this study was to

investigate whether a 5 mg dose of dexamethasone could be enough for, or a larger dose at 8 mg, could be more capable of preventing PONV in women undergoing desflurane anesthesia for thyroidectomy. The results of this Study showed that in PONV prophylaxis, in female patients undergoing desflurane anesthesia for thyroidectomy, the effect of dexamethasone 8 mg was superior to that of dexamethasone 5 mg.

Sebastien et al(2002)[46] The latest published score considers four risk factors: female gender, previous history of PONV or motion sickness, non-smoking status and postoperative use of opioids (Apfel-score). The previously published score includes, in addition to these factors, duration, type of anesthesia and surgery (Sinclair-score). The two scores were compared by and incidence of PONV was predicted. simplified Apfel-score presented with favourable discriminating and calibration properties for predicting the risk of PONV. Therefore implementation of this score in our daily clinical practice as well as in an ongoing antiemetic trial is of great importance.

Tong J. Gan et al (2003)[49] Not all surgical patients will benefit from antiemetic prophylaxis; thus identification of patients who are at increased risk leads to the most effective use of therapy and the greatest cost-efficacy. Although antiemetic prophylaxis cannot eliminate the risk for PONV, it can significantly reduce the incidence. When developing a management strategy for each individual patient, the choice should be based on patient preference, level of PONV risk.

Among the interventions considered, a reduction in baseline risk factors and use of nonpharmacologic therapy are least likely to cause adverse events. PONV prophylaxis should be considered for patients at moderate to high risk for PONV. Depending upon the level of risk, prophylaxis should be initiated with monotherapy or combination therapy. Antiemetic combinations are recommended for patients at high risk for PONV. All prophylaxis in children at moderate or high risk for POV should include combination therapy using a 5-HT3 antagonist and a second drug. If PONV occurs within 6 h postoperatively, patients should not receive repeat dose of the prophylactic antiemetic. An emetic episode more than 6h postoperatively can be treated with any of the drugs used for prophylaxis except dexamethasone and transdermal scopolamine.

Nina Deutsch et al (2003)[38] improvements in surgical and anesthesia techniques and safety over the past several years, there has been a movement toward performing a larger number and different types of surgeries in the outpatient setting.

L. H. J. Eberhart et al (2004)[17] He conducted this survey to evaluate the applicability of risk scores developed and tested in adult patients in 983 paediatric patients (0–12 yr) undergoing various surgical procedures. He concluded that specialized scores for children are required. These might use the history of PV, strabismus surgery, duration of anaesthesia >45 min, age >5 yr and administration of postoperative opioids as independent risk factors.

Christian C. Apfel et al (2004)[11] Because antiemetic interventions are similarly effective and act independently, the safest or least expensive should be used first. Prophylaxis is rarely warranted in low-risk patients, moderate-risk patients may benefit from a single intervention, and multiple interventions should be reserved for high-risk patients.

Norbert Roewer et al (2004)[39] Several risk scores were developed to predict PONV. For adult inpatients undergoing balanced anesthesia, a simplified risk score based on the number of the four risk factors (female gender, history of PONV or motion sickness, nonsmoking status, and expected need for postoperative opioids) seem to provide a valid risk assessment. When 0, 1, 2, 3, or 4 of the four factors are present, the patient's risk for PONV is about 10, 20, 40, 60, or 80%, respectively.

Duck Hwan Choi et al (2005)[15] selected five major risk factors ($p \leq 0.000$) to develop a predictive model. With this risk model, we can readily predict the probability of PONV of individual patient. As an example, if a non-smoking female patient who has a history of motion sickness undergoes a subtotal gastrectomy for 3 hr and receives PCA -based opioid, her probability of PONV would be 65%.we identified the major predictive risk factors for PONV through this large-scaled study in a Korean population and developed a Korean predictive model for PONV.

In addition, this model can be used to calculate the probability of PONV in order to administer prophylactic antiemetics in selected high-risk patients.

Samia N. Khalil et al (2005)[45] ondansetron was effective when administered to pediatric patients before the start of surgery. Compared with placebo, ondansetron given before surgery resulted in significantly fewer patients exhibiting emesis and delayed onset of emesis in those who did exhibit emesis.

Anthony L. Kovac et al (2005)[2] believes that in moderate, high-, and very high-risk patients, the benefits prophylaxis for PONV, PDNV, and OINV outweigh the risks, side effects, and cost of antiemetic medications and are preferable to giving no prophylaxis.

Alessandro C. Silva et al (2006)[1] Suggested that Postoperative nausea and vomiting (PONV) is the most common postoperative complication after surgery and general anesthesia. PONV occurs primarily within the first 24 hours and can lead to significant morbidity, delayed hospital discharge, increased hospital costs and perhaps most importantly, poor patient satisfaction.

40.08% experienced PONV during the first 24 hours after surgery. The most important predictive factors associated with an increased risk of PONV were female gender, young patients (15 to 25 years old), nonsmoking status, presence of predisposing factors (i.e., prior history of motion sickness and/or PONV, vertigo or migraine headaches), use of volatile general anesthetics, maxillary surgery, postoperative pain level and the use of postoperative analgesic opioid drugs. He found a directly proportional relationship between

the number of risk factors and the prevalence of PONV. He concluded in his study that there was a high prevalence of PONV among patients undergoing orthognathic surgery.

Jan Wallenborn et al (2006)[28] This large randomised trial showed that the addition of 25mg or 50mg metoclopramide to dexamethasone (given intraoperatively) reduces postoperative nausea and vomiting.

Tong J. Gan et al (2007)[50] Not all surgical patients will benefit from antiemetic prophylaxis; thus, identification patients who are at increased risk is imperative. first step in reducing PONV risk is to reduce baseline risk factors among patients at risk.

Drugs for PONV prophylaxis for adults should be considered for use as monotherapy or in combination for patients at moderate risk for PONV.

There is increasing evidence that the combination of several potentially beneficial factors (multimodal approach) may lead to an improved outcome.

Tatsuya Ichinohe et al (2007)[48] evaluated the effect of supplemental nitrous oxide on postoperative nausea and vomiting (PONV) after propofol anesthesia for orthognathic surgery in female and nonsmoking patients.

By comparing PONV in 28 ASA-I female nonsmoking patients undergoing orthognathic surgery. Anesthesia was induced with propofol combined with fentanyl, and tracheal intubation was facilitated with

vecuronium. Anesthesia was maintained with propofol with or without nitrous oxide. No patient received neostigmine. PONV was assessed as score 0 (no PONV), score 1 (nausea), and score 2 (vomiting) during the 24-hour recovery period.

There was also no difference in PONV score in 2 groups. Only 1 patient in each group vomited. He concluded that supplemental nitrous oxide does not aggravate PONV after propofol anesthesia for orthognathic surgery in female nonsmoking patients.

Ethan Oliver Bryson et al (2007)[18] Prophylaxis for PONV is neither cost-effective nor indicated for low risk patients, and most medium risk patients can be effectively treated with a single agent. When administering an anesthetic to a patient at high risk for developing PONV, the plan should include pre-medication to reduce anxiety, agents that reduce the need for intraoperative and postoperative opioids, and the use of regional anesthetic techniques whenever possible. If general anesthesia cannot be avoided, agents such as propofol for induction and maintenance of anesthesia should be used to avoid or reduce the need for nitrous oxide and the potent inhaled agents.

A combination of antiemetic prophylactic agents should be administered to those judged to be at high risk for developing PONV, and adequate intravenous therapy should avoid dehydration and hypotension postoperatively.

Michael J et al (**2007**)[36] All combinations were associated with a low incidence of nausea vomiting. dexamethasone 2 mg plus ondansetron 2 mg not significantly different to other dose combinations except that, groups receiving 2 mg dexamethasone alone had a more frequent incidence of nausea.

Werner Joseph et al (2008)[53] The exact mechanism of smoking reducing the incidence of PONV is not fully explained; however, there are several potential explanations. Chronic exposure to one of the chemicals in tobacco may desensitize the patient to anesthetic gas or may a have direct antiemetic effect. Another explanation is that the cytochrome p450 may be up-regulated in chronic smokers, which may increase metabolism of anesthetic agents and result in less PONV.

F. Yoshikawa et al (2009)[19] Hypotensive anaesthesia using sodium nitroprusside or nitroglyerine reduced blood loss and the duration of mandibular osteotomy.The hormonal responses, indicated by plasma levels of ACTH, cortisol and dopamine, were activated by SNP, NTG and sevoflurane in the control group. No significant difference in these hormonal responses was observed between the 3 groups. SNP and NTG can be used safely for hypotensive anaesthesia during mandibular osteotomy if mean arterial pressure is maintained between 60 and 70 mmHg.

Waleed Riad et al (2009)[51] Pediatric strabismus surgery is commonly associated with higher incidence of postoperative nausea and vomiting (PONV). Mixtures of different classes of antiemetics have been used successfully to decrease the incidence of PONV but there was no agreement

on the optimal combination. The aim of this study was to investigate the effect of granisetron, ondansetron, midazolam combination with dexamethasone in the prevention of PONV following strabismus repair in pediatric population.

He concluded from the study that Prophylactic administration of either of either granisetron, ondansetron, midazolam combined with dexamethasone markedly decreases the incidence of PONV following strabismus surgery in pediatrics. All combinations are equally effective.

Ju Ahmed et al (2009)[31] A non -randomized case control study of prevention of post operative nausea and vomiting with IV- Granisetron was done on 270 adult surgical patients who received general or spinal anesthesia. All the patients were followed up to 48 hours after operation. A complete response was achieved in prophylaxis group as 92.6% and in control group as 90.4% (p-value=0.6637).Majority of patients (90 to 100 %) had PONV within 24 hours after operation. As there is insignificant difference in the achievement between prophylaxis group and control group, anti emetic prophylaxis is recommended only for patient with one or more risk factors for PONV.

Mohan Alexander et al (2009)[37] concluded that there does not appear to be a rationale for the prophylactic administration of antiemetic drugs in such surgical procedures. A watch-and-wait policy and simple GL may provide significant relief. Antiemetic medications are to be considered only in case.

REVIEW OF LITERATURE

J.W. Dundee et al (1975)[16] The ability of cyclizine (50 mg) and perphenazine (2.5 and 5.0 mg) to counteract the emetic effects of pethidine (100 mg) and morphine (10 and 15 mg) was compared in women undergoing a standard minor operation with a standard anaesthetic. Perphenazine (5.0 mg) was as effective an anti-emetic as cyclizine (50 mg) and both were more effective than perphenazine (2.5 mg). The reduction in vomiting and nausea by cycizine (50 mg) and perphenazine (5 mg) was approximately the same following pethidine (100 mg) and morphine (10 mg) but much less against the larger dose of morphine. Both anti-emetics had a rapid onset of action but their anti-emetic activity did not last as long as the emetic effect of morphine. Perphenazine (5 mg) was accompanied by an unacceptably high incidence of restlessness. In clinical practice cyclizine (50 mg) is preferred to perphenazine (5 mg) as an antiemetic.

Carolyn M. Flanary et al (1983)[7] The authors surveyed 93 orthognathic surgery patients about presurgical concerns, preparation for the surgical experience, and postsurgical outcomes.

Nine of the 90 respondents indicated they would not re-elect the surgical treatment. Reasons for dissatisfaction varied, although all had in common the occurrence of unanticipated postsurgical events. The importance of effective preoperative preparation of patients cannot be overestimated. The authors have

written an information brochure to reinforce verbal orientation for the orthognathic surgery patient and family.

Claude A. Trtpanier et al (1993)[12] . Aspiration of gastric contents with an orogastric tube does not decrease postoperative nausea and vomiting in outpatients. Patients who receive this treatment had higher incidence of nausea and vomiting after their discharge from the day surgery unit.

Carrol et al (1995)[8] reported a prevalence of over 30% of postdischarge nausea and vomiting for up to 5 days after surgery.

David S. Precious et al (1997)[14] compared the effectiveness of patient-controlled intravenous (IV) opioid analgesic administration (PCA) with fixed schedule and dosage oral/rectal administration of naproxen, and opioid analgesics intramuscularly/orally as needed (IM/PO Prn) for postoperative analgesia over a period of 48 to 56 hours after surgery. There were 75 orthognathic patients aged 25.73+_8.01 years. Subdivided into three study groups of 25: codeine group; naproxen group and PCA group. The degree of analgesia was assessed every 4 hours from 8:00AM to 8:00 PM on days 1 and 2 post surgery using a visual analog scale. The PCA group used less than half the amount of morphine equivalent as the codeine group. Both the naproxen and the PCA groups were significantly more comfortable than the codeine group during day 1 and day 2 post surgery.

The codeine group had significantly more episodes of nausea than either the naproxen or the PCA groups. He finally concluded that patients

undergoing orthognathic surgery, naproxen and PCA regimens provided better analgesia than the codeine regimen.

Girish P. Joshi et al (1999)[20] suggested that the incidence of postoperative nausea and vomiting and the need for antiemetics do not increase with the use of neostigmine and glycopyrrolate for reversal of residual muscle paralysis.

Laara et al, (1999)[34] it appears that this risk score has broad applicability in predicting PONV in adult patients undergoing inhalational anesthesia for various types of surgery. For patients with at least two out of these four identified predictors a prophylactic antiemetic strategy should be considered.

Sinclair et al (1999)[47] A validated mathematical model is provided to calculate the risk of PONV in outpatients having surgery. Knowing the factors that predict PONV will help anesthesiologists determine which patients will need antiemetic therapy.

Paul F. White, et al (1999)[40] if patients experience breakthrough PONV despite prophylaxis, they should be treated with a drug from a group other than the one used for prophylaxis (e.g., metoclopramide).

Craig Wagley et al ,(1999)[13] conducted an investigation to evaluate the efficacy of ondansetron in controlling postoperative nausea and vomiting (PONV) when used prophylactically in patients undergoing routine dentoalveolar surgery performed under general anesthesia.

This was a prospective, double-blind, randomized, placebo-controlled evaluation. Fifty adult ASA I or II patients, requiring routine dentoalveolar surgery performed under general anesthesia, without a prior history of PONV, were randomly assigned to the experimental or control groups. Ondansetron (2.0 mL = 4.0 mg) or normal saline (2.0 mL) were administered intravenously before surgery. Age, gender, type of surgery, duration of surgery, anesthetic dosages, and PONV were evaluated. PONV was evaluated at time 0 (end of anesthesia) and at 30 and 60 minutes postoperatively.

Nausea was evaluated using a visual analog scale (1, not nauseous; 5, about to vomit). Vomiting was assessed as a yes or no response. At 20 to 28 hours postoperatively,

No significant differences ($P < .05$) were found between the PONV groups for gender, duration of procedure, or anesthetic dosages. No statistically significant differences ($P < .05$) were noted between groups for nausea or vomiting.

He finally concluded that, there were no significant differences between ondansetron and placebo for prophylaxis against PONVof nonresponders and intractable PONV.

Robert M. Dolman et al (2000)[42], conducted a prospective study to compare the quality of the surgical field, blood loss, and operative time with either hypotensive or normotensive anesthesia during Le Fort I osteotomies.

Twenty-three patients were randomized into normotensive or hypotensive anesthesia treatment groups. The quality of the surgical field was assessed intraoperatively by direct observation and again postoperatively using video imaging. A standardized rating scale was applied at specific intervals by surgeons blinded to the anesthetic technique. The surgical time was measured on the videotape, and blood loss was measured by volumetric and gravimetric techniques. There was a statistically significant correlation ($P < .0001$) between the surgeon's perception of the quality of the surgical field and the blood pressure. There was also a statistically significant reduction ($P < .01$) in blood loss when using hypotensive anesthesia. However, there was no statistically significant reduction in operative time when using hypotensive anesthesia. It was concluded that hypotensive anesthesia is valuable in reducing blood loss and improving the quality of the surgical field during Le Fort I osteotomies, allowing for easier, more deliberate, and careful dissection. However, it does not reduce operative time.

Jacqueline E. Jones et al (2001)[26] gastric aspiration does not decrease the incidence of vomiting following tonsillectomy.

Yi Lee et al ,(2001)[54] Desflurane is associated with a higher incidence of 24-h postoperative nausea and vomiting (PONV) as compared with sevoflurane or isoflurane. Dexamethasone 5 mg i.v. is suggested to be the minimum effective dose for prophylaxis of PONV in women undergoing thyroidectomy with isoflurane anesthesia. The objective of this study was to

investigate whether a 5 mg dose of dexamethasone could be enough for, or a larger dose at 8 mg, could be more capable of preventing PONV in women undergoing desflurane anesthesia for thyroidectomy. The results of this Study showed that in PONV prophylaxis, in female patients undergoing desflurane anesthesia for thyroidectomy, the effect of dexamethasone 8 mg was superior to that of dexamethasone 5 mg.

Sebastien et al(2002)[46] The latest published score considers four risk factors: female gender, previous history of PONV or motion sickness, non-smoking status and postoperative use of opioids (Apfel-score). The previously published score includes, in addition to these factors, duration, type of anesthesia and surgery (Sinclair-score). The two scores were compared by and incidence of PONV was predicted. simplified Apfel-score presented with favourable discriminating and calibration properties for predicting the risk of PONV. Therefore implementation of this score in our daily clinical practice as well as in an ongoing antiemetic trial is of great importance.

Tong J. Gan et al (2003)[49] Not all surgical patients will benefit from antiemetic prophylaxis; thus identification of patients who are at increased risk leads to the most effective use of therapy and the greatest cost-efficacy. Although antiemetic prophylaxis cannot eliminate the risk for PONV, it can significantly reduce the incidence. When developing a management strategy for each individual patient, the choice should be based on patient preference, level of PONV risk.

Among the interventions considered, a reduction in baseline risk factors and use of nonpharmacologic therapy are least likely to cause adverse events. PONV prophylaxis should be considered for patients at moderate to high risk for PONV. Depending upon the level of risk, prophylaxis should be initiated with monotherapy or combination therapy. Antiemetic combinations are recommended for patients at high risk for PONV. All prophylaxis in children at moderate or high risk for POV should include combination therapy using a 5-HT3 antagonist and a second drug. If PONV occurs within 6 h postoperatively, patients should not receive repeat dose of the prophylactic antiemetic. An emetic episode more than 6h postoperatively can be treated with any of the drugs used for prophylaxis except dexamethasone and transdermal scopolamine.

Nina Deutsch et al (2003)[38] improvements in surgical and anesthesia techniques and safety over the past several years, there has been a movement toward performing a larger number and different types of surgeries in the outpatient setting.

L. H. J. Eberhart et al (2004)[17] He conducted this survey to evaluate the applicability of risk scores developed and tested in adult patients in 983 paediatric patients (0–12 yr) undergoing various surgical procedures. He concluded that specialized scores for children are required. These might use the history of PV, strabismus surgery, duration of anaesthesia >45 min, age >5 yr and administration of postoperative opioids as independent risk factors.

Christian C. Apfel et al (2004)[11] Because antiemetic interventions are similarly effective and act independently, the safest or least expensive should be used first. Prophylaxis is rarely warranted in low-risk patients, moderate-risk patients may benefit from a single intervention, and multiple interventions should be reserved for high-risk patients.

Norbert Roewer et al (2004)[39] Several risk scores were developed to predict PONV. For adult inpatients undergoing balanced anesthesia, a simplified risk score based on the number of the four risk factors (female gender, history of PONV or motion sickness, nonsmoking status, and expected need for postoperative opioids) seem to provide a valid risk assessment. When 0, 1, 2, 3, or 4 of the four factors are present, the patient's risk for PONV is about 10, 20, 40, 60, or 80%, respectively.

Duck Hwan Choi et al (2005)[15] selected five major risk factors ($p \leq 0.000$) to develop a predictive model. With this risk model, we can readily predict the probability of PONV of individual patient. As an example, if a non-smoking female patient who has a history of motion sickness undergoes a subtotal gastrectomy for 3 hr and receives PCA -based opioid, her probability of PONV would be 65%.we identified the major predictive risk factors for PONV through this large-scaled study in a Korean population and developed a Korean predictive model for PONV.

In addition, this model can be used to calculate the probability of PONV in order to administer prophylactic antiemetics in selected high-risk patients.

Samia N. Khalil et al (2005)[45] ondansetron was effective when administered to pediatric patients before the start of surgery. Compared with placebo, ondansetron given before surgery resulted in significantly fewer patients exhibiting emesis and delayed onset of emesis in those who did exhibit emesis.

Anthony L. Kovac et al (2005)[2] believes that in moderate, high-, and very high-risk patients, the benefits prophylaxis for PONV, PDNV, and OINV outweigh the risks, side effects, and cost of antiemetic medications and are preferable to giving no prophylaxis.

Alessandro C. Silva et al (2006)[1] Suggested that Postoperative nausea and vomiting (PONV) is the most common postoperative complication after surgery and general anesthesia. PONV occurs primarily within the first 24 hours and can lead to significant morbidity, delayed hospital discharge, increased hospital costs and perhaps most importantly, poor patient satisfaction.

40.08% experienced PONV during the first 24 hours after surgery. The most important predictive factors associated with an increased risk of PONV were female gender, young patients (15 to 25 years old), nonsmoking status, presence of predisposing factors (i.e., prior history of motion sickness and/or PONV, vertigo or migraine headaches), use of volatile general anesthetics, maxillary surgery, postoperative pain level and the use of postoperative analgesic opioid drugs. He found a directly proportional relationship between

the number of risk factors and the prevalence of PONV. He concluded in his study that there was a high prevalence of PONV among patients undergoing orthognathic surgery.

Jan Wallenborn et al (2006)[28] This large randomised trial showed that the addition of 25mg or 50mg metoclopramide to dexamethasone (given intraoperatively) reduces postoperative nausea and vomiting.

Tong J. Gan et al (2007)[50] Not all surgical patients will benefit from antiemetic prophylaxis; thus, identification patients who are at increased risk is imperative. first step in reducing PONV risk is to reduce baseline risk factors among patients at risk.

Drugs for PONV prophylaxis for adults should be considered for use as monotherapy or in combination for patients at moderate risk for PONV.

There is increasing evidence that the combination of several potentially beneficial factors (multimodal approach) may lead to an improved outcome.

Tatsuya Ichinohe et al (2007)[48] evaluated the effect of supplemental nitrous oxide on postoperative nausea and vomiting (PONV) after propofol anesthesia for orthognathic surgery in female and nonsmoking patients.

By comparing PONV in 28 ASA-I female nonsmoking patients undergoing orthognathic surgery. Anesthesia was induced with propofol combined with fentanyl, and tracheal intubation was facilitated with

vecuronium. Anesthesia was maintained with propofol with or without nitrous oxide. No patient received neostigmine. PONV was assessed as score 0 (no PONV), score 1 (nausea), and score 2 (vomiting) during the 24-hour recovery period.

There was also no difference in PONV score in 2 groups. Only 1 patient in each group vomited. He concluded that supplemental nitrous oxide does not aggravate PONV after propofol anesthesia for orthognathic surgery in female nonsmoking patients.

Ethan Oliver Bryson et al (2007)[18] Prophylaxis for PONV is neither cost-effective nor indicated for low risk patients, and most medium risk patients can be effectively treated with a single agent. When administering an anesthetic to a patient at high risk for developing PONV, the plan should include pre-medication to reduce anxiety, agents that reduce the need for intraoperative and postoperative opioids, and the use of regional anesthetic techniques whenever possible. If general anesthesia cannot be avoided, agents such as propofol for induction and maintenance of anesthesia should be used to avoid or reduce the need for nitrous oxide and the potent inhaled agents.

A combination of antiemetic prophylactic agents should be administered to those judged to be at high risk for developing PONV, and adequate intravenous therapy should avoid dehydration and hypotension postoperatively.

Michael J et al (2007)[36] All combinations were associated with a low incidence of nausea vomiting. dexamethasone 2 mg plus ondansetron 2 mg not significantly different to other dose combinations except that, groups receiving 2 mg dexamethasone alone had a more frequent incidence of nausea.

Werner Joseph et al (2008)[53] The exact mechanism of smoking reducing the incidence of PONV is not fully explained; however, there are several potential explanations. Chronic exposure to one of the chemicals in tobacco may desensitize the patient to anesthetic gas or may a have direct antiemetic effect. Another explanation is that the cytochrome p450 may be up-regulated in chronic smokers, which may increase metabolism of anesthetic agents and result in less PONV.

F. Yoshikawa et al (2009)[19] Hypotensive anaesthesia using sodium nitroprusside or nitroglyerine reduced blood loss and the duration of mandibular osteotomy.The hormonal responses, indicated by plasma levels of ACTH, cortisol and dopamine, were activated by SNP, NTG and sevoflurane in the control group. No significant difference in these hormonal responses was observed between the 3 groups. SNP and NTG can be used safely for hypotensive anaesthesia during mandibular osteotomy if mean arterial pressure is maintained between 60 and 70 mmHg.

Waleed Riad et al (2009)[51] Pediatric strabismus surgery is commonly associated with higher incidence of postoperative nausea and vomiting (PONV). Mixtures of different classes of antiemetics have been used successfully to decrease the incidence of PONV but there was no agreement

on the optimal combination. The aim of this study was to investigate the effect of granisetron, ondansetron, midazolam combination with dexamethasone in the prevention of PONV following strabismus repair in pediatric population.

He concluded from the study that Prophylactic administration of either of either granisetron, ondansetron, midazolam combined with dexamethasone markedly decreases the incidence of PONV following strabismus surgery in pediatrics. All combinations are equally effective.

Ju Ahmed et al (2009)[31] A non -randomized case control study of prevention of post operative nausea and vomiting with IV- Granisetron was done on 270 adult surgical patients who received general or spinal anesthesia. All the patients were followed up to 48 hours after operation. A complete response was achieved in prophylaxis group as 92.6% and in control group as 90.4% (p-value=0.6637).Majority of patients (90 to 100 %) had PONV within 24 hours after operation. As there is insignificant difference in the achievement between prophylaxis group and control group, anti emetic prophylaxis is recommended only for patient with one or more risk factors for PONV.

Mohan Alexander et al (2009)[37] concluded that there does not appear to be a rationale for the prophylactic administration of antiemetic drugs in such surgical procedures. A watch-and-wait policy and simple GL may provide significant relief. Antiemetic medications are to be considered only in case.

RESULTS

A total of 25 patients were analyzed in this survey.

Of the 25 patients included in the study 5 patients (20%) experienced PONV.

Gender & Age

Our population consisted of 40% male (10/25) & 60% females (15/25) with a female to male ratio of 3:2.

Among 5 patients who developed PONV 40% (2/5) were male and 60% (3/5) were females.

The relationship between PONV and female gender was not statistically significant based on the p value criteria

The age of the patients enrolled in this study ranged from 15-50 years with a mean of 32.5

Patients aged between 15-25 yrs showed greatest incidence of PONV (60%), with a noteworthy statistically significant reduction of emetic events with increasing of age.

Age & PONV were statistically related ($P = 0.041$)

There was decrease in incidence of PONV as age increased and a higher incidence of PONV in females in all age groups compared with males.

Table 1 : Frequency of PONV in different age groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Below 20	6	24.0	24.0	24.0
	21-25	14	56.0	56.0	80.0
	Above 25	5	20.0	20.0	100.0
	Total	25	100.0	100.0	

Table 2 : Percentage of PONV Vs. Age

			PONV				Total
Age Group in years			1	2	3	4	
	Below 20	Count	2	0	1	3	6
		% within Age Group in years	33.3%	.0%	16.7%	50.0%	100.0%
		% within PONV	11.8%	.0%	100.0%	60.0%	24.0%
	21-25	Count	12	0	0	2	14
		% within Age Group in years	85.7%	.0%	.0%	14.3%	100.0%
		% within PONV	70.6%	.0%	.0%	40.0%	56.0%
	Above 25	Count	3	2	0	0	5
		% within Age Group in years	60.0%	40.0%	.0%	.0%	100.0%
		% within PONV	17.6%	100.0%	.0%	.0%	20.0%
Total		Count	17	2	1	5	25
		% within Age Group in years	68.0%	8.0%	4.0%	20.0%	100.0%
		% within PONV	100.0%	100.0%	100.0%	100.0%	100.0%

Pearson Chi-Square test and Co-relation test were performed

P = 0.041 (significant)

Table 3 : Frequency of PONV in Male and Female Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	10	40.0	40.0	40.0
	Female	15	60.0	60.0	100.0
	Total	25	100.0	100.0	

Table 4 : Percentage of PONV Vs. Gender

Gender			PONV				Total
			1	2	3	4	
	Male	Count	7	1	0	2	10
		% within Gender	70.0%	10.0%	.0%	20.0%	100.0%
		% within PONV	41.2%	50.0%	.0%	40.0%	40.0%
	Female	Count	10	1	1	3	15
		% within Gender	66.7%	6.7%	6.7%	20.0%	100.0%
		% within PONV	58.8%	50.0%	100.0%	60.0%	60.0%
Total		Count	17	2	1	5	25
		% within Gender	68.0%	8.0%	4.0%	20.0%	100.0%
		% within PONV	100.0%	100.0%	100.0%	100.0%	100.0%

Pearson Chi-Square test and Co-relation test were performed

P value = 0.76 (not statistically significant)

Co-morbidities, ASA Status

None of the patients had any co-morbidities. Only 2/25 patients were ASA II (81%). Of the two patients, 1 patient (50%) experienced PONV.

The result showed no statistical relationship between co-morbidity and incidence of PONV (P = 0.062)

- Patients were classified as ASA I 23 (92%) and ASA II (8%) 2 patients.
- X^2 test relating ASA (classification) to PONV did not show a statistical relationship (P= 0.062)

Table 5 : Frequency of PONV in ASA I & ASA II

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I	23	92.0	92.0	92.0
	II	2	8.0	8.0	100.0
	Total	25	100.0	100.0	

Table 6 : Percentage of PONV Vs. ASA status

ASA Status		PONV				Total
		1	2	3	4	
I	Count	17	1	1	4	23
	% within ASA Status	73.9%	4.3%	4.3%	17.4%	100.0%
	% within PONV	100.0%	50.0%	100.0%	80.0%	92.0%
II	Count	0	1	0	1	2
	% within ASA Status	.0%	50.0%	.0%	50.0%	100.0%
	% within PONV	.0%	50.0%	.0%	20.0%	8.0%
Total	Count	17	2	1	5	25
	% within ASA	68.0%	8.0%	4.0%	20.0%	100.0%

	Status % within	100.0%	100.0%	100.0%	100.0%	100.0%

Smoking status

All patients included in this study were non-smokers 25/25 (100%).

Incidence of PONV is higher in non smoking population .

Predisposing factors : History of motion sickness, prior PONV, Vertigo, migraine and headaches.

- Majority of the patients medical charts did not report any predisposing factors. 24 patients had no predisposing factors (96%). 1 patient (4%) had History of motion sickness and experienced PONV.
- Of all the predisposing factors , a prior history of PONV was the most important predictive factor of PONV.

Preanaesthetic medication:

All patients 25/25 100% received preanaesthetic medication.

All patients received Fortwin (IM), Phenargan (IM) & glycopyrrolate (IM)

No statistically significant correlation with PONV was established.

Mensturation & Hormone therapy:

Of 14 (56%) female patient only 1 (4%) patient had menstruation during her period of admission. She experienced PONV in the postoperative period.

No stastistically significant correlation was established with PONV

Intraoperative factors & PONV

Site of Surgery

Most of the patients (12) 48% in this study underwent bimaxillary surgeries

Maxillary surgeries alone in 9 patients (36%)

Mandibular surgeries alone in 4 patients (16%)

In our study incidence of PONV was higher in patients undergoing bimaxilary procedures.

Table 7 : PONV rates according to surgical sites

Surgical Sites	Patients with PONV	Percentage of PONV	Total Patients	Percentage of Total
Mandible	1	25%	4	16%
Maxilla	0	0%	9	36%
Max/Mand	4	33.3%	12	48%
Total	**5**	20%	25	100%

Duration of procedure

There was statistically significant correlation between the procedure duration and PONV ($p = 0.01$)

The longer the procedure, the greater was the incidence of PONV.

Table 8 : PONV rates and procedure duration

Duration In hours	Patients with PONV	Percentage of PONV	Total number of patients	Percentage of total
2.30 - 3.00	0	0%	7	28%
3.00 -3.30	1	11.1%	9	36%
3.30 – 4.00	2	50%	4	16%
4.00 – 4.30	2	66.6%	3	12%
4.30 – 5.00	0	0	2	8%

Medications

All patients received steroids (Dexamethasone 8mg intravenously) intraoperatively and postoperatively for two days 12 hourly . Antibiotics - Cefotaxim (1gm/IV) was given intraoperatively and postoperatively, continued for 3 days 12 hourly . In few patients Ampicillin (500mg/IV) was given intraoperatively and postoperatively continued for 3 days 8 hourly .

Metrogyl (500mg/IV) was given intraoperatively and postoperatively for 3 days 8 hourly . Medication was changed to oral antibiotic syrups after the third day and continued for 5 more days.

Emset 4mg (IV) was given intraoperatively for all patients and continued postoperatively for the two days at 12 hour interval. Rantidine 50mg IV was given intraoperatively and postoperatively for all patients.

No allergic reactions were noticed in any of the patients.

Anaesthetic medications :

In majority of the patients, anaesthesia was induced using Sodium Thiopentone (IV) in 23 patients (92%), Propofol, Glycopyrrolate, Fortwin in 2 (8%) cases was given intravenously.

Inhalation agents used were nitrous oxide & oxygen in 6 patients (24%) and Nitrous Oxide along with Oxygen and 0.5% intermittent halothane in 19 patients (76%) to maintain general anaesthesia.

- Incidence of PONV was higher (80%) when an inhalation agent (Halothane 0.5% Intermittent) was used along with Nitrous Oxide and Oxygen compared to 20% when Nitrous Oxide and Oxygen used alone.
- Approximately 4 patients experienced PONV (80%) when Halothane 0.5% Intermittent was used along with Nitrous Oxide and Oxygen. Only one patient experienced PONV (20%) when only Nitrous Oxide and Oxygen was used.
- Hypotensive anaesthesia in the form of Nitroglycerine IV drip was given in all patients at the beginning of the procedure.
- Intraoperative Opioids were not used.
- Voveran (IM) was administered in all 25 patients and of these, 5 (20%) experienced PONV. Muscle relaxants like Norcurarium was used along with succinylcholine. Reversal drugs like Neostigmine

2.5 mg (IV) was used in all cases in addition to Glycopyrrolate 0.5mg (IV)

- When used, the most common of these was glycopyrrolate (0.5mg IV) combined with neostigmine (2.5mg IV).
- Statistical analysis was not possible since all the patients were treated with the same protocol.

POSTOPERATIVE FACTORS AND PONV

There were 20 patients who did not experience PONV (80%). Among those patients who did experience PONV (20%, 5/25), all episodes occurred only in the PACU.

Postoperative Analgesics

Postoperative pain was treated in both the PACU and SSU, on a12 hourly basis, with intramuscular NSAIDS (Voveran 3ml IM). After the 2nd postoperative day pain was treated on "as and when basis".

Pain Level

The pain level was measured using a visual analog scale and rated as mild moderate and severe. This was done consistently in the PACU but was found to be extremely variable in the SSU. As such, the relationship between pain level and the occurrence of PONV was only evaluated while patients were in the PACU .

Increase in pain level resulted in increased incidence of PONV.

Table 9 : Percentage of PONV Vs. Pain level

Pain level			PONV				Total
			1	2	3	4	
	Mild	Count	4	1	0	0	5
		% within Pain level	80.0%	20.0%	.0%	.0%	100.0%
		% within PONV	23.5%	50.0%	.0%	.0%	20.0%
	Moderate	Count	9	1	0	0	10
		% within Pain level	90.0%	10.0%	.0%	.0%	100.0%
		% within PONV	52.9%	50.0%	.0%	.0%	40.0%
	Severe	Count	4	0	1	5	10
		% within Pain level	40.0%	.0%	10.0%	50.0%	100.0%
		% within PONV	23.5%	.0%	100.0%	100.0%	40.0%
Total		Count	17	2	1	5	25
		% within Pain level	68.0%	8.0%	4.0%	20.0%	100.0%
		% within PONV	100.0%	100.0%	100.0%	100.0%	100.0%

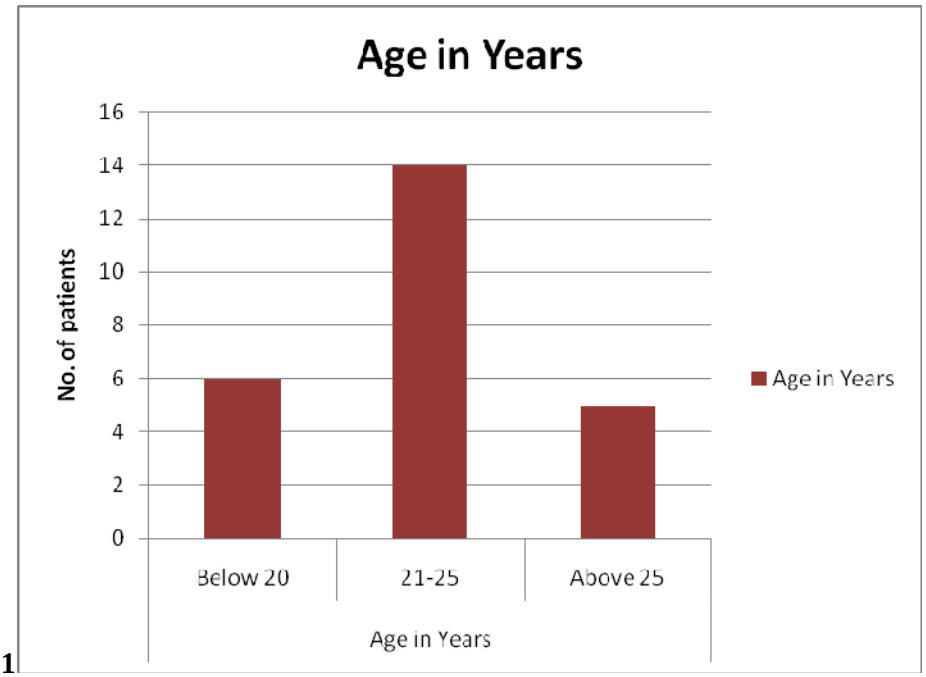
Pearson Chi-Square test and Co-relation test were performed

$P < 0.05$

Antiemetics

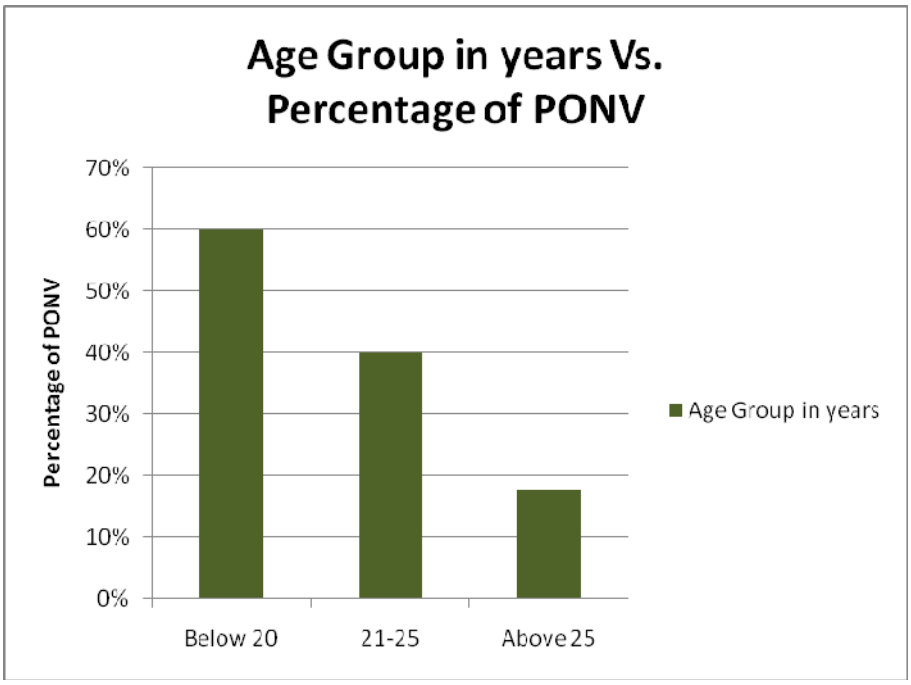
PONV episodes in the PACU were treated with ondansetron 4 mg (IV).

GRAPH

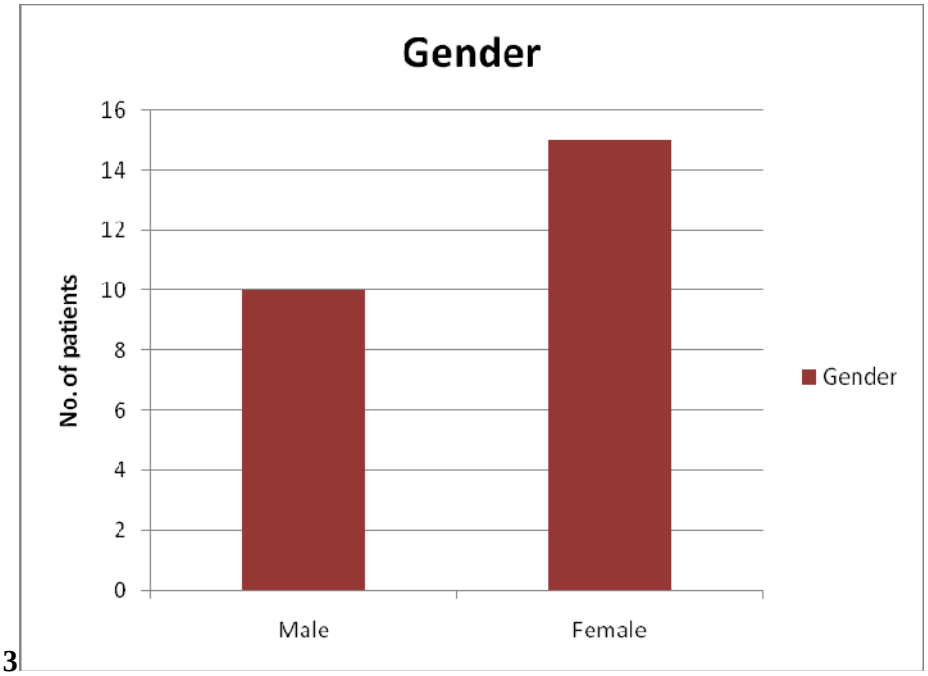


1

GRAPH 2

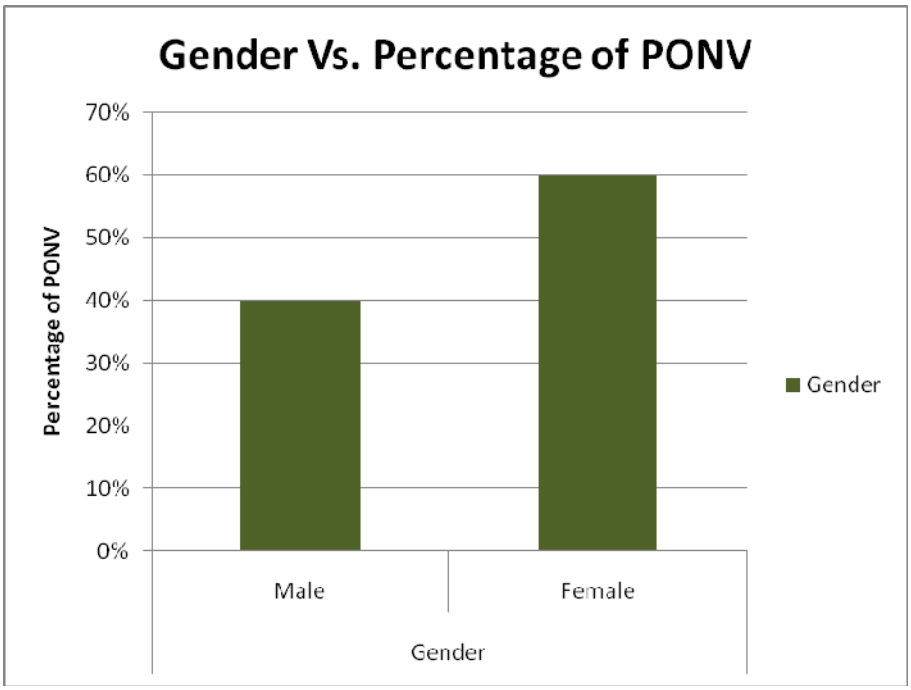


GRAPH

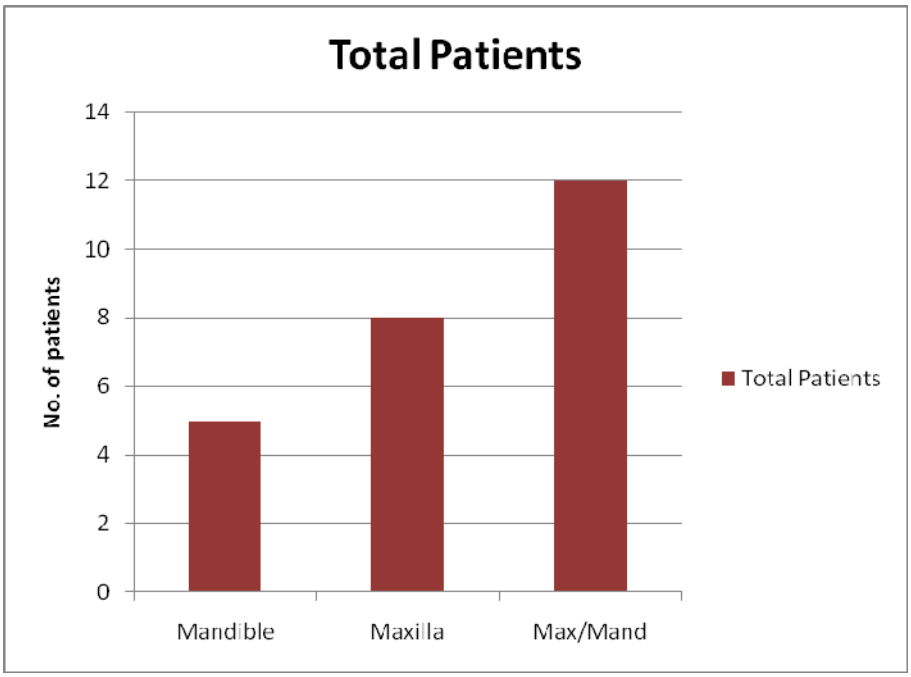


3

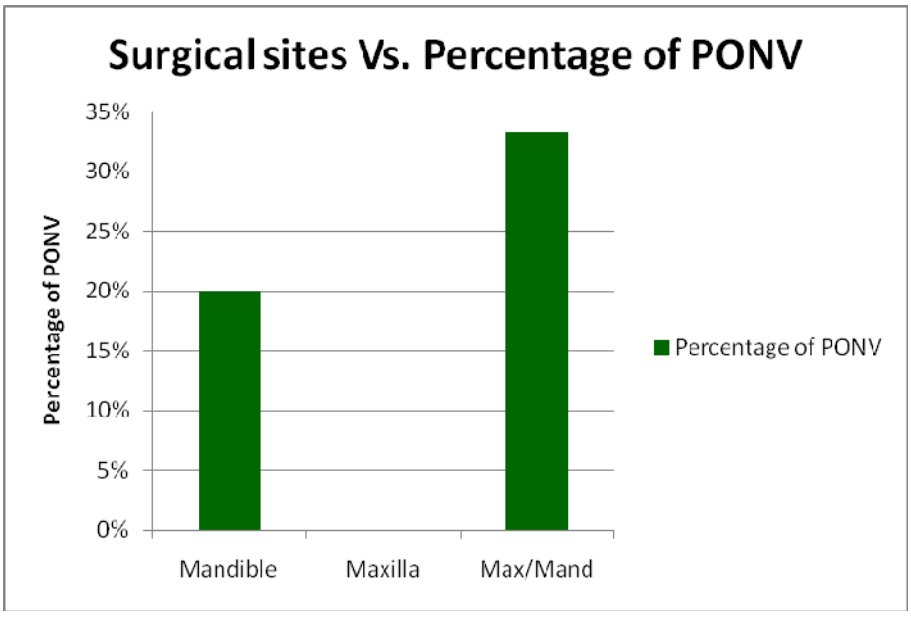
GRAPH 4



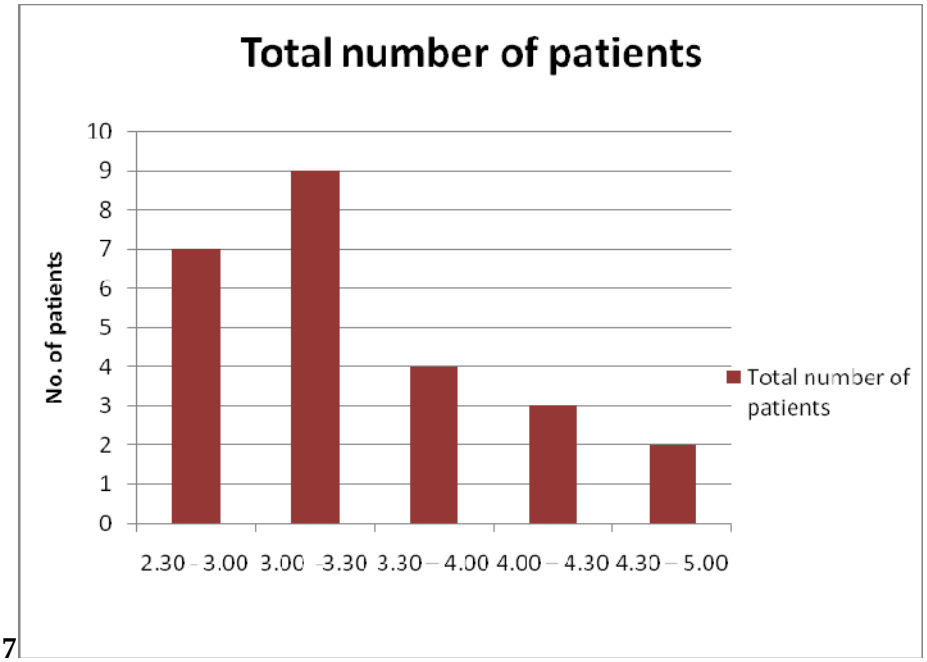
GRAPH 5



GRAPH 6

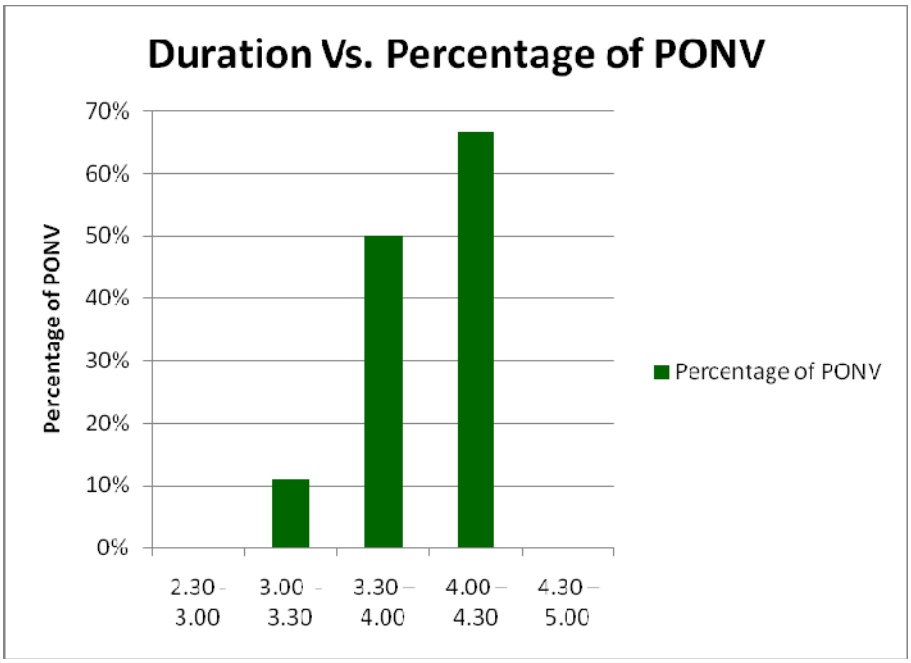


GRAPH

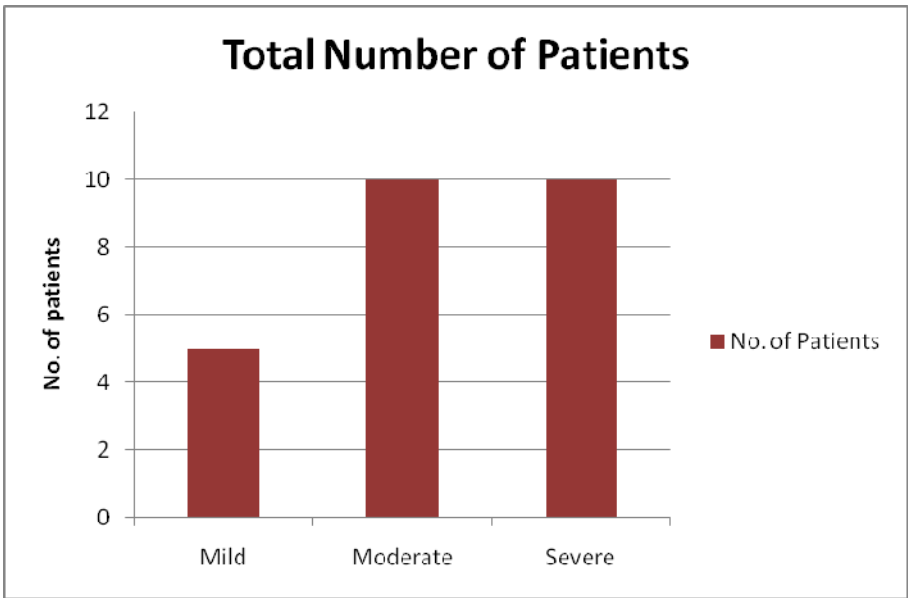


7

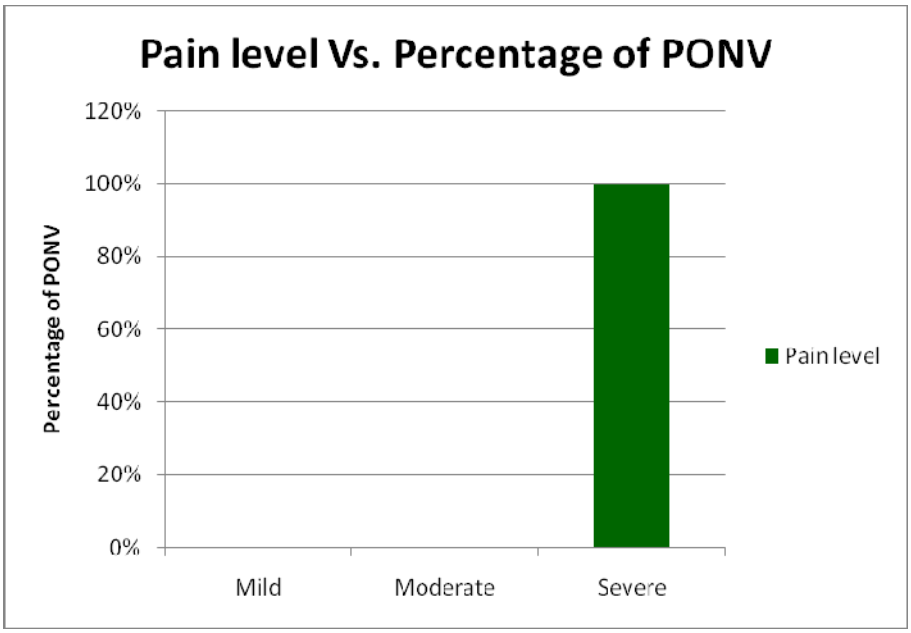
GRAPH 8



GRAPH 9



GRAPH 10



INTRA OPERATIVE

S.NO	Name	Mandibular Procetures			Maxillary Procedures		
		BSSO	Sub apical osteotomy	Genioplasty	Lefort I	Anterior Maxilary Osteotomy	PMO
1	Case 1		Setback		Setup 4 mm	set back	
2	Case 2	Advancement			setup		
3	Case 3			Advancement 7 mm		setup 3mm Set back 5mm	
4	Case 4				Setup (5m)	setup(2 mm) Setback (5 mm)	
5	Case 5			Advancement 5mm		Setup 2mm Setback 5mm	
6	Case 6						Setup
7	Case 7		Setback 4mm			Setback 4mm	
8	Case 8			Advancement 5 mm	setup	setup & setback	
9	Case 9				Advancement 5m		
10	Case 10				Setup	setup & setback	Advancement
11	Case 11					Setup 3mm Set back 3 mm	
12	Case 12				Setup 10	set back	
13	Case 13	advancement					
14	Case 14		Sub apical set back 5m			setup 2m Set back 5m	
15	Case 15				setup		
16	Case 16	Setback 8mm			Advancement 4mm		
17	Case 17				5mm impaction	Setup 7mm Set back 6.5 mm	
18	Case 18	Advancement				setup 2m Set back	
19	Case 19			Advancement + Reduction	Setup 7		
20	Case 20			Advancement	Setup 5mm Set back 3mm		
21	Case 21						Setup
22	Case 22	Advancement 6mm					
23	Case 23			Reduction 5 + Advancement	setup 5	set back	
24	Case 24	Advancement 6m		Advancement - 3m			
25	Case 25	Advancement 6m		Advancement - 5m			

S.NO	Name	Antimetics	Pain level	.
1	Case 1	Emset 4 mg	Severe	2
2	Case 2	Emset 4 mg	Severe	3
3	Case 3	Emset 4 mg	Moderate	0
4	Case 4	Emset 4 mg	Moderate	0
5	Case 5	Emset 4 mg	Mild	0
6	Case 6	Emset 4 mg	Moderate	1
7	Case 7	Emset 4 mg	Severe	3
8	Case 8	Emset 4 mg	Severe	3
9	Case 9	Emset 4 mg	Moderate	0
10	Case 10	Emset 4 mg	Severe	0
11	Case 11	Emset 4 mg	Mild	0
12	Case 12	Emset 4 mg	Moderate	0
13	Case 13	Emset 4 mg	Severe	0
14	Case 14	Emset 4 mg	Mild	0
15	Case 15	Emset 4 mg	Mild	0
16	Case 16	Emset 4 mg	Severe	3
17	Case 17	Emset 4 mg	Moderate	0
18	Case 18	Emset 4 mg	Mild	1
19	Case 19	Emset 4 mg	Severe	0
20	Case 20	Emset 4 mg	Moderate	0
21	Case 21	Emset 4 mg	Moderate	0
22	Case 22	Emset 4 mg	Severe	0
23	Case 23	Emset 4 mg	Moderate	0
24	Case 24	Emset 4 mg	Severe	3
25	Case 25	Emset 4 mg	Moderate	0

DISCUSSION

The results of this study showed a incidence of 20% PONV among orthognathic surgery patients during their hospital stay . We verified Apfel's 4-factor risk score in our patient population and found that the multimodal prophylaxis for PONV was not particularly effective for high risk patients.

We found that the most important risk factors in our patient population were:

1. Younger age (especially those in the 15 to 25 year old group)
2. Patients with any reported predisposing factors for PONV
3. Surgical procedures that lasted longer than 2 hours
4. Bimaxillary surgeries
5. The use of any inhalational agent
6. Patients who reported high levels of pain in the PACU

This study has specifically analyzed the incidence of PONV, and related risk factors, among orthognathic surgery patients. Nausea and vomiting were considered a single event and termed as PONV. The incidence of PONV was monitored in PACU(20%).

There is an increasing concern that the actual incidence of PONV after hospital discharge may be underestimated. Carrol et al[8] reported the prevalence of 30% post discharge PONV for upto 5 days after surgery.

Associated orofacial swelling, and swallowing blood are common in the early postoperative period after orthognathic surgery, especially those surgeries in which the maxilla was involved. The combination of all these factors may be associated with a higher incidence of PONV.

The risk factors can be divided into nonanesthetic or preoperative related factors, anesthetic or intraoperative surgery related factors and postoperative-related factors.

PREOPERATIVE-RELATED FACTORS

Many patient characteristics can influence the incidence of PONV. Among these are: Age, gender, previous history of PONV, motion sickness, vertigo or migraine headaches. In our population, we found a statistically significant relationship between age and PONV. The younger the patient, the more likely they were to experience PONV. We observed a marked reduction in PONV as the patient's age increased .Sinclair et al [47] described similar results, pointing out that age decreased the likelihood of PONV by 13% for every 10-year increase of age. Our patient population consisted of all nonsmoking individuals . It is well-known that adult males are less likely to experience PONV than are adult females (Watcha MF [52,] White PF)

Our results showed an approximate 20% of high incidence of PONV among females compared to males and suggest a statistical influence of female gender on the incidence of PONV.

One explanation may be the intense fluctuation in hormone levels during the menstrual cycle[1,25]. Women have an increased risk of PONV i.e 2 to 3 times greater than men.[1,34.]Many investigators have stated that nonsmoking patients are more susceptible to PONV than are smokers, especially when other risk factors are considered..

Apfel and his colleagues[4,34], hypothesized about the relationship of smoking and PONV, suggested that smoking may have an effect on the dopaminergic system, thereby diminishing PONV. In the same way, Chimbira and Sweeney [10] have suggested the possibility that inhibition of emetic events by cigarettes may be due to increased hepatic enzymes, especially cytochrome P450. These isoenzymes are responsible for the breakdown, and early excretion, of ingested or inhaled chemicals and toxins, thus diminishing the emetic effect of such drugs. The mechanism by which smoking could contribute to decreased PONV is not completely understood, but the role of hepatic enzymes seems to be the most reasonable explanation. We did not observe such a relationship. This may be due absence of smoking individuals in our study.

Comparing the mean age of the patients with ASA group, Watcha et al and White et al [52,32] found an increase in the mean age as the ASA status increased. Although the actual number of patients who self-reported any risk factors was small. In our study we could not establish a statistically significant relationship between a positive history of predisposing factors and

PONV. Some studies have suggested a relationship between patients medical status and the occurrence of PONV [52,32]. Our results did not reach statistical significance, as only 2 patients were ASA II .

INTRAOPERATIVE-RELATED FACTORS

The etiology of PONV is complex and involves a number of interrelated pathways. Intraoperative and anesthetic factors play a major role in its occurrence. The type of surgery is an independent risk factor for the development of PONV. In order to analyze surgical site and duration with PONV, we divided the procedures into those performed only in the mandible, only in the maxilla, or both. Our data showed a greater number of emetic episodes when the mandible (20%) was involved, with the greatest frequency of PONV in the bimaxillary surgery group .A number of explanations for this finding are possible. One explanation may be the greater average length of surgery time for bimaxillary surgeries versus isolated maxillary or mandibular surgeries. Unlike previous studies which have shown higher incidence of PONV in maxillary surgery , our study showed a higher percentage of PONV in isolated mandibular surgeries. This could be attributed to the longer duration of mandibular surgeries.

Emesis can be initiated by noxious stimuli affecting peripheral receptors which indirectly activate vagal afferent fibers and therefore stimulate the CTZ. Blood in the stomach is considered to be one of the strongest peripheral emetogenic stimuli. Throatpack in the oropharynx was placed in all

patients at the beginning of all orthognathic procedures and all patients received gastric suctioning at the end of the procedure.

Some authors have suggested placing the nasogastric tube at the beginning of the surgical procedure not only to evacuate gastric contents, but also to decompress gastric distention that may occur after vigorous preoperative mask ventilation. But on contrary in some cases nasogastric tube can even increase the incidence of PONV by stimulating the glossopharyngeal nerve. The main role of blood in the stomach, as an important emetic factor, is not well understood. Clinically, we observed that those patients who were experiencing PONV usually noted good relief of their emetic symptoms after expulsion of their gastric contents, especially patients who vomited blood clots.

In our patients it was found that the longer the surgery, the higher the incidence of PONV. Sinclair et al [47] found that the prevalence of PONV increased from 2.8% in patients whose surgery was less than 30 minutes to 27.7% in patients with a surgical duration of 150 to 180 minutes. One possible explanation for these findings is the greater accumulation of emetogenic drugs, specifically those drugs related to the general anesthetic [3]. Our results were similar, demonstrating an increase of PONV in surgeries longer than 2 hours.

Among the anesthetic factors that may influence the incidence of PONV, the most commonly defined are: inhalation agents, neuromuscular

reversal drugs[20], dehydration, hypotension, and the use of prophylactic antiemetic drugs. General anesthesia can be provided by IV medications and/or inhaled volatile anesthetics[1]. At our institution, sodium thiopentone for induction and halothane 0.5% for maintenance, were the most commonly administered anesthetic drugs.

Although total IV anesthesia may lead to reduced PONV, it can be somewhat difficult to maintain a normotensive or mildly hypotensive mean arterial blood pressure, which is desired in maxillary and bimaxillary procedures.GA can be provided by IV medication and or inhaled volatile anaesthetic (Alessandro C Silva etal [1]) Propofol for induction and either desflurane or sevoflurane for maintenance were the most commonly administered anaesthetic drugs. They found higher prevalence of PONV in patients whom volatile anaesthesia was used 41.48% and the incidence of PONV reduced to 14.81% for total IV anaesthesia..

Apfel et al [3] considered the use of volatile anaesthetics as the main cause of early PONV (0-2 hrs), however with no impact on later postoperative period (2-24hrs).

Hofer et al [24] reports the reduction of PONV with total IV General anaesthesia alone used for surgeries of short duration (less than 60 minutes) and that involved only the mandible (BSSO). Although total IV anaesthesia may lead to reduced PONV it can be somewhat difficult to maintain normotensive or mildly hypotensive mean arterial blood pressure which is

desired in maxillary and bimaxillary procedures. They are more expensive and also requires Opioids or Beta Blockers for arterial blood pressure control. Hence the best approach for rapid recovery with lower incidence of PONV seems to be when all three drug types – Volatile inhalation agents, IV hypnotics and Opioids are properly dosed (Betts NJ, Turvey et al [5]).

The combination of nitrous oxide and opioids results in a higher frequency of PONV compared to inhalation general anesthetics that did not involve nitrous oxde . In our analysis we verified the influence of inhalation agents on the incidence of PONV. However PONV was significant when nitrous oxide was used in combination with halothane 0.5%. Liberal intravenous fluid administration and supplemental oxygen therapy have been thought to reduce the incidence of PONV. Liberal intravenous fluid infusion decreases the amount of oral fluids requested by the patients in the immediate postoperative period, thus decreasing gastric upset and subsequent emesis. Our patients' level of hydration was routinely based on the length of the surgical procedure and the amount of blood loss.

Supplemental intraoperative oxygen is also a subject of controversy. Some authors have proposed its use for PONV reduction [21,30], but most have questioned its efficacy. Because oxygen is inexpensive and essentially risk-free, supplemental oxygen can and should be used and may be an effective tool in avoiding PONV.

Intraoperatively, the inhalation agents were delivered together with either oxygen or nitrous oxide/oxygen. Postoperatively, all patients received supplemental oxygen during their hospital stay for a minimum of three hours till the patient maintains 100% oxygen saturation. It has been suggested that the use of more than one prophylactic antiemetic drug, acting at different receptor sites, is more effective than the use of a single drug [22]. However, antiemetic prophylaxis alone is not the only preventive factor to be considered. The literature has suggested that, in high-risk patients, a multimodal approach (volatile anesthetic avoidance and antiemetic administration) has shown the best results. Apfel et al [11] were the first to identify and define these risk factors. They found female gender, smoking status, history of previous PONV or motion sickness, and the postoperative use of opioids were the most important risk factors associated with PONV. The emetic prevalence increased proportionally with the number of risk factors identified: none (10%), 1 (21%), 2 (39%), 3 (61%), or 4 (79%).

The most common risk factors in our patients were: female gender, predisposing PONV factors (history of motion sickness) surgical site, procedure duration, volatile general anesthetic use and pain level. The assessment of the PONV risk factors in each individual patient is a foundation for evidence-based recommendations for the management of PONV. Comparing costs of anesthetic drugs alone (direct costs) is inappropriate, as postoperative adverse events such as PONV may be associated with secondary

expenses (indirect costs). Thus, identification of risk for adverse outcomes appears to be a more efficient and inexpensive way to comprehensively manage these patients.

POSTOPERATIVE-RELATED FACTORS

NSAIDS are commonly used postoperatively in our orthognathic surgery patients. Nausea is frequently accompanied by pain in the early postoperative period and the relief of pain resulted in relief of nausea as well. The basic mechanism of pain-induced emesis is still not well understood; however, it has been suggested that pain is associated with emesis via activation of the sympathetic nervous system. Jenkins and Lahay [29] first proposed a relationship between emesis and increased circulating catecholamines. Researchers have emphasized the role of pain as a primary factor in emesis initiation. Our results also showed a trend of increased PONV with increasing pain level. Our standard protocol for postoperative pain management involves administration of intramuscular administration of voveran 3 ml . Our results indicate that pain may be an influencing factor in the occurrence of PONV, but this was evaluated only in the PACU.

Most of our patients experienced PONV within the first 2 hours after surgery. We also observed more emetic events when patients experience the greatest level of pain and requested pain relief medication.

The main goal of this research was to identify the most common patient , anesthetic and surgically related risk factors for PONV and develop efficient preventive protocols to this common and unpleasant problem.

CONCLUSION

The prospective data of 25 patients were collected from department of oral and maxillofacial surgery, Ragas dental college and hospital , Chennai. The age of patients ranged between 15 to 50 years with a mean age of 32.5 years. The incidence of postoperative nausea and vomting was assessed based on following factors: preanesthetic factors which include age, sex, previous history of motion sickness, habits like smoking ,preanesthetic medication, ASA status , reaction to prior anesthetics ,history of menstruation or harmone therapy. Intraoperative anesthetic factors which include duration of the procedure, type of anesthesia ,inhalation agents used ,neuromuscular blockers, IV anesthetics ,antiemetics, reversal drugs, antibiotics and steroids used. surgical factors include surgical site. Postoperative factors include analgesics used antiemetics, pain level .

The patients were observed in the post anesthetic care unit for signs of nausea and vomiting during the the first 24 hours after the surgical procedure under general anesthesia.

The following conclusions can be derived from this study :

1. There was difference in postoperative nausea and vomiting with regard to age. Patients in young age group between 15 to 20 years showed high incidence of PONV compared to other groups.

2. Percentage of females with PONV was higher than males . The value was statistically not significant.
3. Only 2 patients were ASA II , of them one patient experienced PONV.
4. Only one patient had a history of motion sickness and experienced PONV.
5. PONV was high in patients undergoing bimaxillary surgeries compared to isolated jaw surgeries.
6. Incidence PONV increased with duration of the surgery. Longer the surgery, higher was the incidence of PONV.
7. Incidence of PONV was higher when an inhalation agent (halothane) was used along with nitrous oxide.
8. Increase in pain level increased the incidence of PONV.

Although some risk factors mentioned above have been found to be significantly associated with incidence of postoperative nausea and vomiting , further studies are needed with a larger sample size to confirm these findings.

BIBLIOGRAPHY

1. **Alessandro C. Silva,** Postoperative Nausea and Vomiting (PONV) after Orthognathic Surgery: A Retrospective Study and Literature Review; (J Oral Maxillofac Surg 64:1385-1397, 2006)
2. **Anthony L. Kovac, MD** The Prophylactic Treatment of Postoperative Nausea and Vomiting in Oral and Maxillofacial Surgery(J Oral Maxillofac Surg 63:1531-1535, 2005)
3. **Apfel CC, Kranke P, Katz MH, et al**: Volatile anaesthetics may be the main cause of early but not delayed postoperative vomiting: A randomized controlled trial of factorial design. Br J Anaesth 88:659, 2002.
4. **Apfel CC, Rauch S, Goepfert C, et al**: The impact of smoking on postoperative vomiting. Anesthesiology 87:25A, 1997
5. **Betts NJ, Turvey** TA: Oral and Maxillofacial Surgery. Orthognathic Surgery . Philadelphia, PA, Saunders, 2000,
6. **C M Ku,** Postoperative Nausea and Vomiting: A Review of Current Literature. (Singapore Med J 2003 Vol 44(7) : 366-374).
7. **Carolyn M. Flanary**, Patient Responses to the Orthognathic Surgical Experience: Factors Leading to Dissatisfaction. (J Oral Maxillofac Surg 41:770- 774. 1983)
8. **Carrol NV, Miederhoff P, Cox FM, et al**: Postoperative nausea and vomiting after discharge from outpatient surgery centers Anesth Analg 80:903, 1995.

9. **Chia YY, Kuo MC, Liu K, et al**: Does postoperative pain induce emesis? Clin J Pain 18:317, 2002.
10. **Chimbira W, Sweeney BP**: The effect of smoking on postoperative nausea and vomiting. Anaesthesia 55:540, 2000.
11. **Christian C. Apfel** A Factorial Trial of Six Interventions for the Prevention of Postoperative Nausea and Vomiting.(N Engl J Med 2004; 350:2441-2451June 10, 2004)
12. **Claude A. Trtpanier** Perioperative gastric aspiration increases postoperative nausea and vomiting in outpatients (Canadian journal of anesthesia 1993 / 40: 4 / pp 325-8).
13. **Craig Wagley**, The Effect of Preoperative Ondansetron on the Incidence of Postoperative Nausea and Vomiting in Patients Undergoing Outpatient Dentoalveolar Surgery and General Anesthesia. (J Oral Maxiliofac Surg 57: 1 195-l 200. 1999.)
14. **David S. Precious,** A Comparison of Patient-Controlled and Fixed Schedule Analgesia After Orthognathic Surgery.(J Oral Maxillofac Surg 55;33-39, 1997.)
15. **Duck Hwan Choi**, A Korean Predictive Model for Postoperative Nausea and Vomiting.(J Korean Med Sci 2005; 20: 811-5.)
16. **Dundee J.W.**, A Comparison of the Efficacy of Cyclizine and Perphenazine in reducing the emetic effects of Morphine and Pethidine. (Br. J. Clin. Pharmac. (1975), 2, 81-85)

17. **Eberhart L.H.J,** Applicability of risk scores for postoperative nausea and vomiting in adults to paediatric patients. British Journal of Anaesthesia 93 (3): 386–92 (2004).
18. **Ethan Oliver Bryson***, Management of the Patient at High Risk for Postoperative Nausea and Vomiting. (M.E.J. Anesth 19 (1), 2007.)
19. **F. Yoshikawa** Blood loss and endocrine responses in hypotensive anaesthesia with sodium nitroprusside and nitroglycerin for mandibular osteotomy. Int. J. Oral Maxillofac. Surg. 2009; 38: 1159–1164
20. **Girish P. Joshi**, The Effects of Antagonizing Residual Neuromuscular Blockade by Neostigmine and Glycopyrrolate on Nausea and Vomiting After Ambulatory Surgery. (Anesth Analg 1999;89:628 –31)
21. **Greif R, Laciny S, Rapf B, et al**: Supplemental oxygen reduces the incidence of postoperative nausea and vomiting. Anesthesiology 91:1246, 1999
22. **Habib AS, Gan TJ**: Combination therapy for postoperative nausea and vomiting: A more effective prophylaxis? Ambul Surg 9:59, 2001.
23. **Hirayama T, Ishii F, Yago K, et al**: Evaluation of the effective drugs for the prevention of nausea and vomiting induced by morphine used for postoperative pain: A quantitative systematic review. Yakugaku Zasshi 121:179, 2001
24. **Hofer CK, Zollinger A, Buchi S, et al**: Patient well-being after general anaesthesia: A prospective, randomized, controlled, multi-centre trial comparing intravenous and inhalation agents. Br J Anaesth 91:631, 2003.

25. **Honkavaara P, Lehtinen AM, Hovorka J, et al**: Nausea and vomiting after gynaecological laparoscopy depends upon the phase of the menstrual cycle. Can J Anaesth 38:876, 1991 Philip BK: Etiologies of postoperative nausea and vomiting.
26. **Jacqueline E. Jones**, Efficacy of Gastric Aspiration in Reducing Posttonsillectomy Vomiting. (Arch Otolaryngol Head Neck Surg. 2001; 127:980-984).
27. **Jakob Walldén** The influence of opioids on gastric function: experimental and clinical studies.(issn 1652-4063 isbn 978-91-7668-583-9).
28. **Jan Wallenborn** ,Prevention of postoperative nausea and vomiting by metoclopramide combined with dexamethasone: randomised double blind multicentre trial.(bmj.38903.419549.80 21 July 2006).
29. **Jenkins LC, Lahay D:** Central mechanisms of vomiting related to catecholamines response. Anesthetic implication. Can Anaesth Soc J 18:434, 1971.
30. **Joris JL, Poth NJ, Djamadar AM, et al**: Supplemental oxygen does not reduce postoperative nausea and vomiting after thyroidectomy Br J Anaesth 9:857, 2003
31. **Ju Ahmed,** Efficacy of Parenteral Granisetron in the Prevention of Post-Operative Nausea and Vomiting.(Journal of Bangladesh College of Physicians and Surgeons Vol. 27, No. 3, September 2009)
32. **Kenny GN**: Risk factors for postoperative nausea and vomiting.Anesthesia 49:6, 1994

33. **Kovac AL**: Prevention and treatment of postoperative nausea and vomiting. Drugs 59:213, 2000.
34. **Laara** A Simplified Risk Score for Predicting Postoperative Nausea and Vomiting: Conclusions from Cross-validations between Two Centers. (Anesthesiology:September 1999 - Volume 91 - Issue 3 - p 693)
35. **Laurance s.friedman etal**, principles of internal medicine ,14th edition. volume I.Harrisons.
36. **Michael J**, Ondansetron and Dexamethasone Dose Combinations for Prophylaxis Against Postoperative Nausea and Vomiting.(Ambulatory Anesthesia Vol. 104, No. 4, April 2007.)
37. **Mohan Alexander**, Prophylactic Antiemetics in Oral and Maxillofacial Surgery—A Requiem?. (J Oral Maxillofac Surg 67:1873-1877, 2009.)
38. **Nina Deutsch**, Patient outcomes following ambulatory anesthesia.. Anesthesiology Clinics of North America 21 (2003) 403– 415.
39. **Norbert Roewer**, MD Risk Assessment of Postoperative Nausea and Vomiting.
40. **Paul F. White,** Postoperative Nausea and Vomiting: Prophylaxis Versus Treatment (Anesth Analg 1999;89:1337–9).
41. **Raymond J Fonseca,** Text Book of Orthognathic Surgery, Volume 2
42. **Robert M. Dolman**, The Effect of Hypotensive Anesthesia on .Blood Loss and Operative Time DuringLe Fort I Osteotomies. . J Oral Maxillofac Surg 58:834-839, 2000.

43. **Rose J B** Postoperative Nausea and Vomiting: a Review of Current Literature. (British journal of anesthesia 1999,83 104 -17).
44. **Saeeda Islam** Post-Operative Nausea and Vomiting (Ponv) :A Review Article (Saeeda, Jain : Ponv : A Review Indian J. Anaesth. 2004; 48 (4) : 253-258
45. **Samia N. Khalil** A Double-Blind Comparison of Intravenous Ondansetron and Placebo for Preventing Postoperative Emesis in 1- to 24-Month-Old Pediatric Patients After Surgery Under General Anesthesia (Anesth Analg 2005;101:356–61)
46. **Sébastien Pierre** Apfel's simplified score may favourably predict the risk of postoperative nausea andvomiting. (Canadian journal of anesthesia 2002 / 49: 3 / pp 237–242).
47. **Sinclair** ,Can Postoperative Nausea and Vomiting Be Predicted. (Anesthesiology : July 1999 - Volume 91 - Issue 1 - p 109–118).
48. **Tatsuya Ichinohe**, Nitrous Oxide Does Not Aggravate Postoperative Emesis After Orthognathic Surgery in Female and Nonsmoking Patients. (J Oral Maxillofac Surg 65:936-939, 2007.)
49. **Tong J. Gan**, Consensus Guidelines for Managing Postoperative Nausea and Vomiting. (Anesth Analg 2003;97:62–71)
50. **Tong J. Gan**, Society for Ambulatory Anesthesia Guidelines for the Management of Postoperative Nausea and Vomiting. (Anesth Analg 2007;105:1615–28).

51. **Waleed Riad*,** Combination Therapy In The Prevention Of Ponv After Strabismus Surgery In Children: Granisetron, Ondansetron, Midazolam With Dexamethasone. (M.E.J. Anesth 20 (3), 2009.)

52. **Watcha MF, White PF**: Postoperative nausea and vomiting: Its etiology, treatment and prevention. Anesthesiology 77:162, 1992.

53. **W**

erner, Joseph The Role of Smoking History in the Development of Postoperative Nausea and Vomiting Anesthesiology:(July2008- Volume 109- Issue 1 - pp 156-157).

54. **Yi Lee**, Prevention of PONV with Dexamethasone in Female Patients undergoing Desflurane Anesthesia for Thyroidectomy.(Acta Anaesthesiol Sin 39:151-156, 2001.)